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(56) Documents Cited
EP 0735446 A2 WO 96/36005 A1

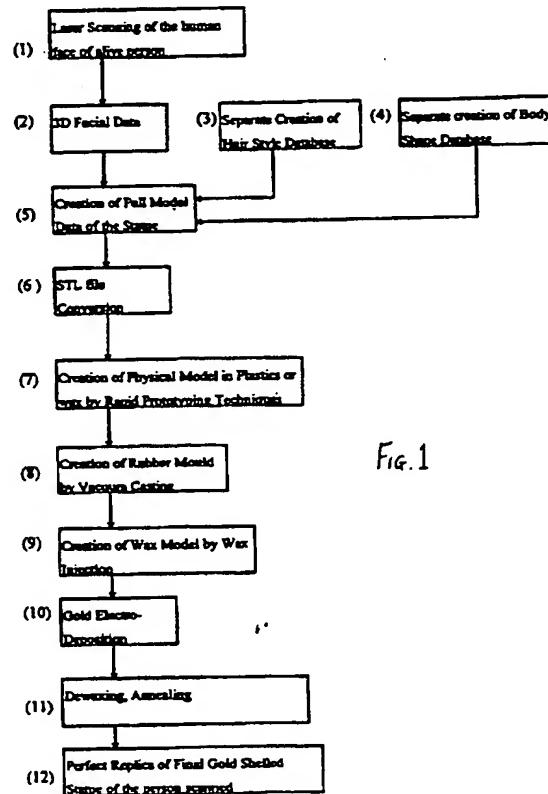
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(54) Abstract Title

Method of moulding a model

(57) A method of making a model of a human which incorporates at least part of a head comprises scanning a human face 1 with a laser to produce three-dimensional face data 2 representative of the shape of the face, combining the face data with hair data 3 representative of the shape of a hair style to produce head data 5 representative of the shape of a human head, the hair data having been selected from a predetermined database of hair shapes, and producing a three-deminsional model 7 of the head from the head data 5. Body data 4 may be selected from a predetermined database of body shapes and combined with the head data 5 to produce combined head and body data representative of the shape of an entire human body.

The three-dimensional model is preferably produced by a rapid prototyping technique 7 such as laser stereolithography, laser sintering or fused deposition modelling.



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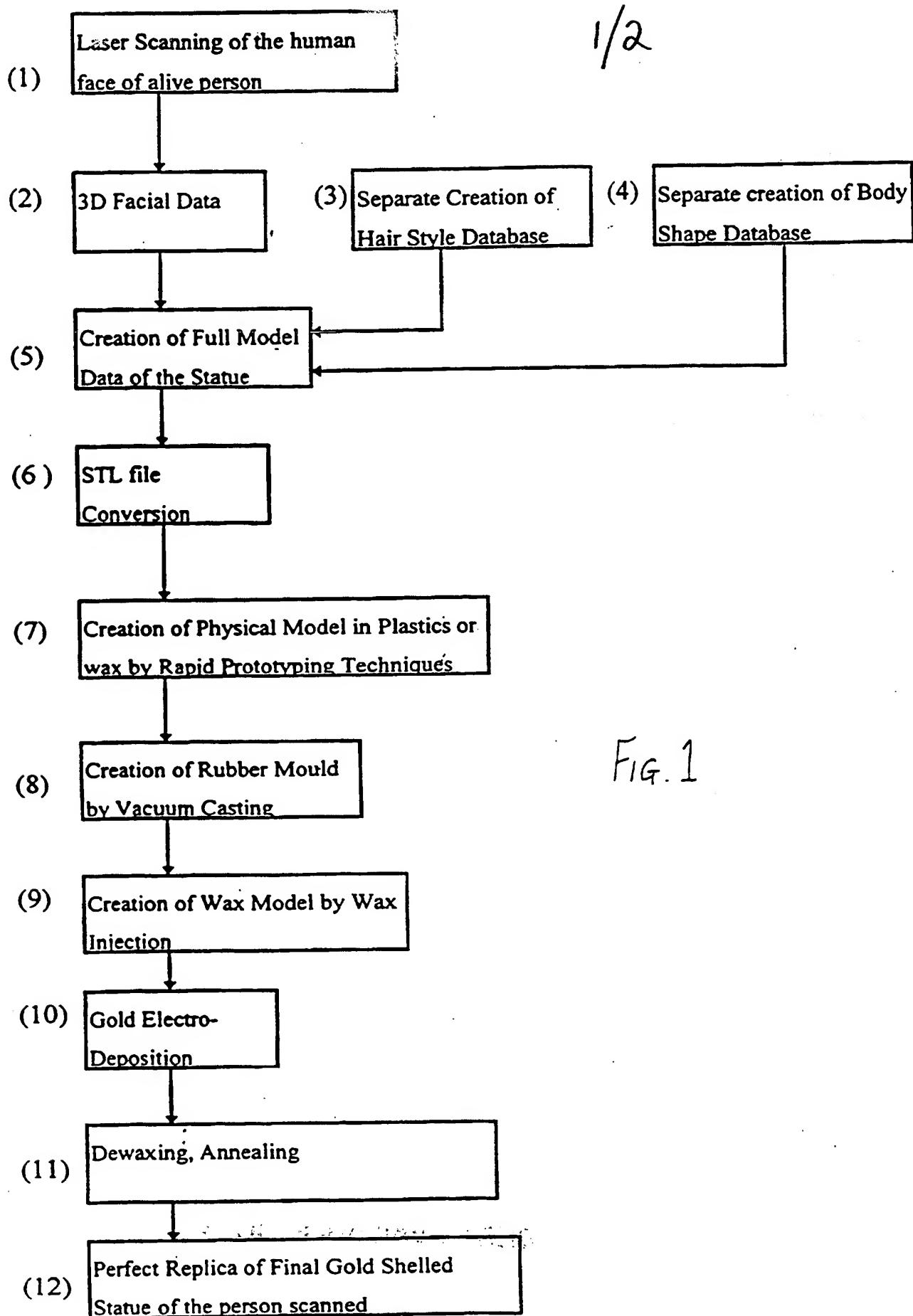


FIG. 1

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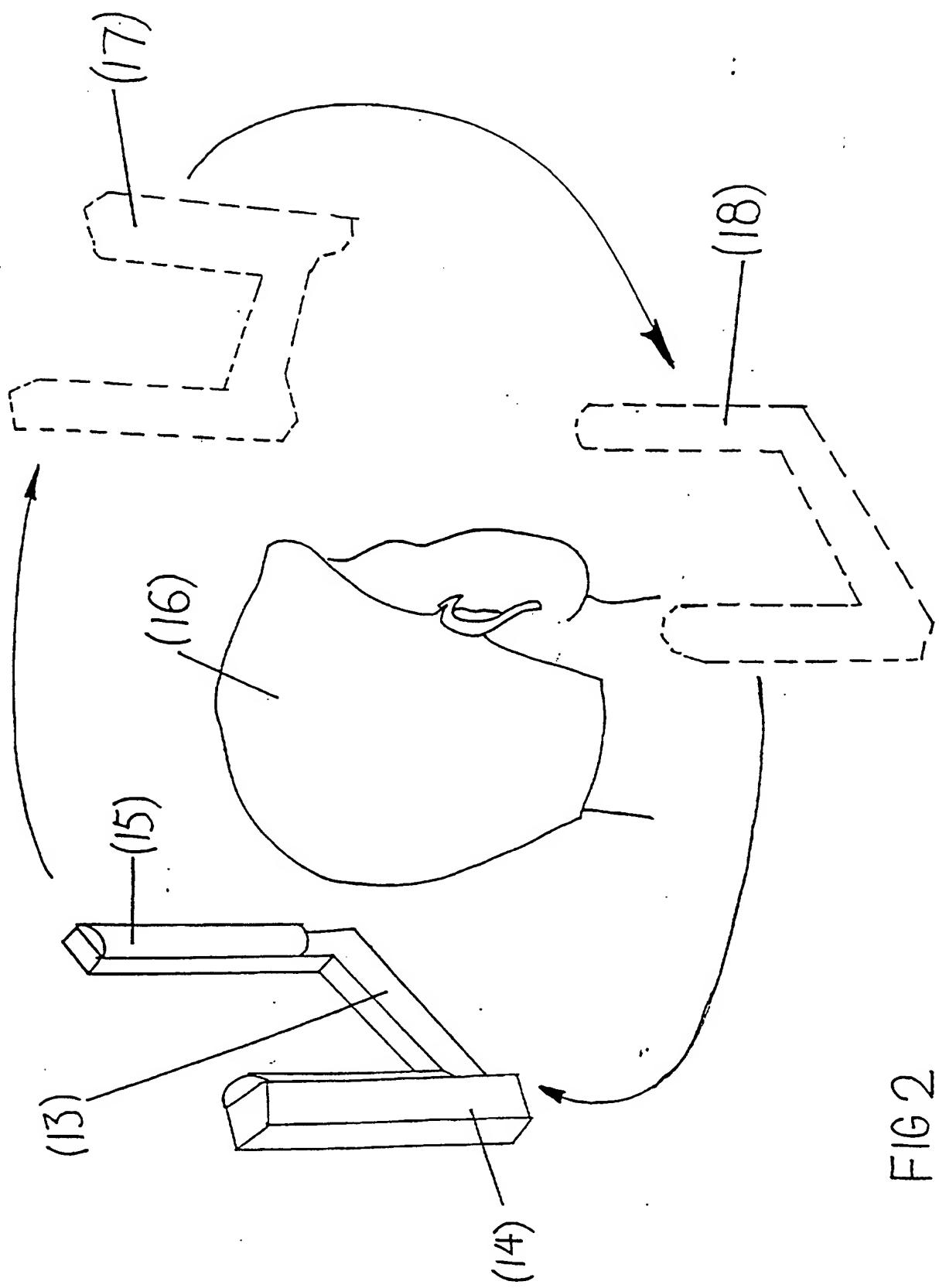


FIG 2

Method of making a model

The present invention relates to a method of making a model of a human, incorporating at least part of the head. In particular, but not exclusively, the invention relates to a method of a statue of a human being in the form of a metal, e.g. gold, shell.

Conventionally, gold shelled statues of humans require extremely high levels of craftsmanship to engrave either a wax master pattern or metal shells. The quality of statues depends on the skill of the craftsman. Moreover, this process is always expensive as it normally takes quite a long time to complete, for example from a few weeks to months.

We have therefore considered the possibility of scanning human facial features with a laser to create digital data defining the shape of the face. However, to make an accurate model of a human head a representation of the hair must also be included. Laser scanning of hair is unsatisfactory as the laser light is diffused by the hair. Thus, an alternative method is required to produce a model of a human.

According to the invention, there is provided a method of making a model of a human which incorporates at least part of a head, wherein the face of the human is scanned with a laser to produce three-dimensional face data representative of the shape of the face, the face data is combined with hair data representative of the shape of a hair style, the hair data being selected from a predetermined database of hair shapes, to produce head data representative of the shape of a human head, and a three-dimensional model of the head is produced from said head data.

Thus, according to the invention, only the facial features are scanned with the laser as the facial skin reflects the laser light acceptably for reception by a scanner sensor. Suitable hair data is added from a database of hair styles so that it is not necessary to scan the hair and the problem of laser diffusion is obviated.

If desired, body data representative of at least part of the shape of a human body from the neck down may be combined with the head data, the body data being selected from a predetermined database of body shapes, to produce combined head and body data representative of the shape of an entire human body. The final three-dimensional model will therefore include at least part of the body.

In this way, diffusion of laser light by the clothing of the human is not a problem or if a model of the naked body is required the human will not be required to undress which may not be appropriate in the situation in which scanning takes place.

The hair and/or body database may be created by scanning pre-created models of e.g. hair styles or bodies with a laser, or may at least in part be created by means of suitable software to simulate the shapes.

The three dimensional model may be created by a rapid prototyping technique such as laser stereolithography, laser sintering or fused deposition modelling.

Once the three dimensional model has been created, preferably a negative mould is made from the three-dimensional model, a wax positive mould is made from the negative mould, the wax positive mould is coated with a

metal by electro-deposition, and the coated wax positive mould is heated to melt the wax and anneal the metal. The metal may be a precious metal, such as gold.

A Class I laser may be used, which is of sufficiently low power that the subject may be scanned with his eyes open.

With the invention, at least in its preferred embodiments, gold shelled statues can be created by the application of laser scanning, computerisation, rapid prototyping, wax modelling and gold electro-deposition. The turnaround time can be shortened to a few days. Moreover, good quality gold replicas of alive people can be produced by this technology which do not depend on the skill level of the operators.

By using non-contact Class I laser digitization (the lowest energy laser approved by the FDA), human facial digitized data can be captured safely with the subject's eyes open. The statue data may then be converted to a rapid prototyping readable format, such as an STL file, to create a physical model. The first model can be produced automatically by a rapid prototyping techniques, such as Laser Stereolithography (SLA) (laser curing a liquid photopolymer layer by layer), Laser Sintering (SLS) (fusing powdered thermoplastic materials with the heat from an infrared laser beam), and Fused Deposition Modelling (FDM) (plastic or wax extrusion from a machine head to deposit on a layer-by-layer basis). By using vacuum casting techniques, a rubber mould can be created which is then used to injection mould a wax statue pattern for the creation of a gold statue. The wax model is used to perform gold electro-deposition which is a process to produce hollow gold jewellery of any shape, including very detailed pieces, without the weight that conventional jewellery

manufacturing methods impose. A gold shelled statue can finally be obtained by dewaxing and annealing the gold shell.

Some embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 shows a flow diagram of an embodiment of the process according to the invention for creating a gold shelled statue by facial scanning and model creation.

Figure 2 shows the schematic layout of a facial scanning system.

Figure 1 is a block diagram which shows schematically the steps followed to create gold shelled statue of an alive human being by facial scanning in accordance with an embodiment of the present invention.

Initially, a person who wants to create his or her own statue is asked to sit in front of the laser scanner for facial scanning (step 1). The three dimensional facial data is obtained by performing a cylindrical scan (step 2). The laser scanner moves around the human head with the centre of the body substantially concentric with the axis of scanner. Due to the difficulty of scanning the hair of a human being, hair models are prescanned separately to create a hair database (step 3). A set of body data is also established by pre-scanning a body model (step 4) by a similar method.

At step 5, the three sets of three-dimensional point data obtained in the previous processes are combined to form a complete set of statue point data. The stored statue data is then converted to STL format (step 6) for

rapid prototyping (step 7) to create a physical plastic or wax model of the statue.

After building the physical prototype, a rubber mould is made by vacuum casting (step 8) using the prototype as a master pattern. The rubber mould is then used for wax injection moulding to produce a wax statue pattern (step 9). This wax pattern is then passed to a gold electro deposition process (step 10) whereby a thin golden shell is formed on the wax pattern. The statue is then passed to an oven for dewaxing and annealing which are necessary to strengthen the thin gold shell (step 11). After the entire process, a final gold shelled statue is made (step 12).

Figure 2 shows the schematic layout of a facial scanner. The person scanned (16) sits calmly on the scanning axis. The scanning head (13) consists of a laser source (14) for emitting a laser beam towards the human face. a CCD camera (15) retrieves the reflected data from the human face. During the scanning process, the laser head rotates for a full revolution about the same axis as that of the human being (following the path in (17) and (18)). Because of the employment of the lowest power laser source (Class I laser according to FDA of US), the human can have open eyes during scanning. This ensures full capture of the facial data of that particular person including his or her eye information.

Thus the embodiment of the invention is, in summary, a method of producing a gold shelled statue of a human being in different sizes comprising the steps of:

- Capturing human facial data by non-contact digitization using the lowest possible energy which a human's eye can tolerate.

- Making use of the digitized facial data and a large database of three-dimensional hair styles and body shapes to create a computer three-dimensional model of the scanned human using various rapid prototyping techniques to create the physical model in plastic or wax.
- Creation of a rubber mould by vacuum casting whereby a wax model can be produced by wax injection.
- Making use of the wax model to create a perfect replica gold shelled statue of the person by gold electro-deposition and dewaxing.

Claims

1. A method of making a model of a human which incorporates at least part of a head, wherein the face of the human is scanned with a laser to produce three-dimensional face data representative of the shape of the face, the face data is combined with hair data representative of the shape of a hair style, the hair data being selected from a predetermined database of hair shapes, to produce head data representative of the shape of a human head, and a three-dimensional model of the head is produced from said head data.
2. A method as claimed in claim 1, wherein body data representative of at least part of the shape of a human body from the neck down is combined with the head data, the body data being selected from a predetermined database of body shapes, to produce combined head and body data representative of the shape of an entire human body.
3. A method as claimed in claim 1 or 2, wherein the database of hair and/or body data is created by scanning models of hair styles and/or body styles with a laser.
4. A method as claimed in any preceding claim, wherein the three-dimensional model is produced by a rapid prototyping technique such as laser stereolithography, laser sintering or fused deposition modelling.
5. A method as claimed in any preceding claim, wherein a negative mould is made from the three-dimensional model, a wax positive mould is made from the negative mould, the wax positive mould is coated with a metal by electro-deposition, and the coated wax positive mould is heated to melt the wax and anneal the metal.

6. A method as claimed in claim 5, wherein the metal is gold.
7. A method as claimed in any preceding claim, wherein the laser used to scan the human face is a Class I laser.
8. A method of making a model of a human substantially as hereinbefore described.
9. A model of a human made by a method as claimed in any preceding claim.



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Application No: GB 9718685.2
Claims searched: 1-9

Examiner: Gavin Dale
Date of search: 14 November 1997

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Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B5A (ATXP)

Int Cl (Ed.6): B29C 67/00

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 735446A2 (KAWAMOTO) See column 4 lines 31-51	1
A	WO 96/36005A1 (FLINT) See page 2 lines 7-19 and page 9 lines 3-6	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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